DELAWARE RIVER BASIN

SPRING RUN, MONROE COUNTY

PENNSYLVANIA

LEVEL II

POCONO HIGHLAND DAM

NDI ID NO. PA-00992

DER ID NO. 45-131

POCONO HIGHLAND CAMPS, INC.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

"Original contains color plates: All DTIC reproductions will be in black and white"

For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

JULY 1981

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DACW31-81-C-0018

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PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

POCONO HIGHLAND DAM

NDI ID No. PA-00992; DER ID No. 45-131

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Pocono Highland Dam NDI ID No. PA-00992 DER ID No. 45-131
Size:	Small (20.2 feet high; 114 acre-feet)
Hazard Classification:	High
Owner:	Pocono Highland Camps, Inc. Mrs. Marion Weinberg, President Marshalls Creek, PA 18335
State Located:	Pennsylvania
County Located:	Monroe
Stream:	Spring Run
Date of Inspection:	1 June 1981

Based on the criteria established for these studies, Pocono Highland Dam is judged to be unsafe, nonemergency, because the spillway capacity is seriously inadequate. The recommended Spillway Design Flood (SDF) for the size and hazard classification of the dam varies between 1/2 of the Probable Maximum Flood (PMF) and the PMF. The selected SDF is the 1/2 PMF. The existing spillway will pass only about 6 percent of the PMF before overtopping of the dam occurs. It is judged that the dam could not withstand the depth and duration of overtopping that would occur for the 1/2 PMF. If the low areas on the top of the dam were filled to the design elevation, the spillway would pass about 11 percent of the PMF without any overtopping. For either condition, the spillway capacity is rated as seriously inadequate. Failure of Pocono Highland Dam would cause an increased hazard for loss of life downstream.

Overall, the dam is considered to be in poor condition. Maintenance of the dam and its appurtenant structures is inadequate.

The following studies and remedial measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform additional studies to more accurately determine the spillway capacity required for Pocono Highland Dam as well as the nature and extent of measures required to provide adequate spillway capacity. Take appropriate action as necessary. If the existing spillway structure is utilized, repairs should be made to existing deteriorated concrete. Before studies are instituted, the spillway outlet channel should be cleared of trees, brush, and fill; in addition, the timber beam on the spillway crest should be removed and the low areas on the top of the dam filled to the design elevation to increase the spillway capacity during the design period.

(2) Remove brush and trees on or near the embankment.

(3) Institute any necessary repairs to make the outlet works operational. In addition, develop a plan to provide upstream closure for the outlet works in case of an emergency.

(4) Visually monitor the seepage areas, the wet area, and the erosion on the upstream slope. Take appropriate action if any condition worsens.

All investigations, studies, designs, and construction inspection should be performed by a professional engineer experienced in the design and construction of dams. Tree removal and removal of fill by the left spillway wall should also be guided by a professional engineer.

In addition, the Owner should institute the following operational and maintenance procedures.

(1) Develop a detailed emergency operation and warning system for Pocono Highland Dam. When warnings of a major storm are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

(2) During periods of unusually heavy rains, provide round-the-clock surveillance of the dam.

(3) As presently required by the Commonwealth, initiate a program of formal annual inspections by a profes ional engineer experienced in the design and construction of dams. Utilize the inspection results to determine if remedial measures are necessary.

(4) Institute a maintenance program and develop a formal maintenance manual so that all features of the dam are properly maintained.

POCONO HIGHLAND DAM

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

FREDERICK FUTCHKO
Project Manager, Dam Section

Date: August 7, 1981

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF
ENGINEERS

JAMES W. PECK
Colonel, Corps of Engineers
Commander and District Engineer

Date: 18 Aug 81

POCONO HIGHLAND DAM

Overview

POCONO HIGHLAND DAM

NID ID No. PA-00992; DER ID No. 45-131

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

SECTION 1

PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Pocono Highland Dam is an earthfill dam that is 347 feet long and 20.2 feet high. The dam has an impervious "puddle" clay core with a timber corewall on the downstream side of the clay core. The embankment has 1V on 2H upstream and downstream slopes. As originally designed and constructed, the topwidth was 8 feet. A subsequent modification widened the topwidth to 13 feet. This modification made the upstream slope above normal pool near-vertical and required that timber beams be placed to retain the downstream side of the upper portion of the embankment.

The spillway is a 33.9-foot long concrete and concrete masonry unit (CMU) gravity structure at the left abutment of the dam. A timber plank bridge with steel I-beams and CMU piers crosses the spillway. The spillway outlet channel extends along the toe of the embankment, which is protected by riprap, to its junction with the outfall of the outlet works.

The outlet works consists of a 12-inch diameter cast-iron pipe (CIP) with a valve at the downstream end.

The various features of the dam are shown on the photographs in Appendix C and on the plates in Appendix E. A description of the geology is included in Appendix F.

b. Location. Pocono Highland Dam is located on Spring Run in Middle Smithfield Township, Monroe County, Pennsylvania. It is about 2.3 miles northeast of the community of Marshalls Creek. The dam is shown on the USGS Quadrangle, Bushkill, Pennsylvania-New Jersey, at latitude N 41° 04.4' longitude W 75° 06.5'. A location map is shown on Plate E-1.

c. Size Classification. Small (20.2 feet high, 114 acre-feet).

d. Hazard Classification. Downstream conditions indicate that a high hazard classification is warranted for Pocono Highland Dam (Paragraphs 3.1e and 5.1c (5)).

e. Ownership. Pocono Highland Camps, Inc.; Mrs. Weinberg, President; Marshalls Creek, Pennsylvania 18335.

f. Purpose of Dam. Recreation.

g. Design and Construction History. Pocono Highland Dam, originally named Reflection Lake Dam, was originally designed by John L. Westbrook, engineer from Stroudsburg, Pennsylvania, in 1927. The dam was designed for Dr. Carl Rosenkrans for boating and fishing. The Commonwealth reviewed the design and issued a permit for construction in October 1927. Construction started soon thereafter and was completed by October 1928. Although not shown on the plans, the spillway weir was constructed with steel pins on the crest to support fish screens. The Commonwealth objected to these pins.

A bridge across the spillway was constructed between 1929 and 1931. The present Owner, under another name, acquired the dam between 1934 and 1937.

Subsequent modifications to the dam include replacement of the spillway bridge with the present structure, raising of the spillway crest with CMUs, and widening the topwidth by constructing a timber retaining wall along the downstream side of the dam near the top. All these modifications were completed prior to 1966. None were noted in the 1949 inspection report by the Commonwealth.

The Commonwealth has ordered, from time to time, correction of various deficiencies at the dam. The Owner has not complied with all of the orders of the Commonwealth.

h. Normal Operational Procedure. The reservoir is maintained at spillway crest with inflow discharging over the spillway.

1.3 Pertinent Data.

a. Drainage Area. (square miles)	1.1
b. Discharge at Damsite. (cfs)	
Maximum known flood	Unknown
Outlet works at maximum pool elevation	12
Spillway capacity at maximum pool elevation	
Design conditions	564
Existing conditions	102
c. Elevation. (feet about msl.)	
Top of dam	
Design conditions	738.8
Existing conditions	738.2
Maximum pool	
Design conditions	738.8
Existing conditions	738.2
Normal pool (design spillway crest)	735.8
Normal pool (existing spillway crest)	737.1
Upstream invert outlet works (Approx.)	718.1
Downstream invert outlet works	718.0
Streambed at toe of dam	718.0
d. Reservoir Length. (miles)	
Normal pool (existing conditions)	0.29
Maximum pool (existing conditions)	0.30
e. Storage. (acre-feet)	
Normal pool (design conditions)	71
Normal pool (existing conditions)	89
Maximum pool (design condtions)	135
Maximum pool (existing conditions)	114
f. Reservoir Surface. (acres)	
Normal pool (design conditions)	12
Normal pool (existing conditions)	15
Maximum pool (design)	40
Maximum pool (existing)	30

g.	Dam.	
	Type	Earthfill
	Length (feet)	347
	Height (feet)	20.2
	Topwidth (feet)	
	Design	8
	Existing	13
	Side Slopes	
	Upstream	1V on 2H; Upper 3 feet are near-vertical
	Downstream	1V on 2H; Upper 3 feet are near-vertical
	Zoning	"Puddle" clay core with earthfill upstream and a combination "earth and stone" fill downstream
	Cutoff	Timber corewall on downstream side of clay core extending to "impervious" material
	Grout Curtain	None
h.	Diversion and Regulating Tunnel.	None
i.	Spillway.	
	Type	Broad-crested concrete and CMU gravity weir
	Length of Weir (feet-existing)	33.9 including 1.3-foot wide pier
	Crest Elevation	
	Design	735.8
	Existing	737.1
	Upstream Channel	Reservoir
	Downstream Channel	Concrete-lined apron

j.	Regulating Outlets.	
	Type	One 12-inch diameter CIP
	Length (feet)	95
	Closure	Valve at downstream end
	Access	Over embankment

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. The data available include design drawings for the original structure, as well as the Commonwealth's review comments for the original design. There is no design information concerning subsequent modifications.

b. Design Features. The project is described in Paragraph 1.2a. The various features of the dam are shown on the photographs in Appendix C and on the plates in Appendix E.

c. Design Considerations. Design information for the dam is limited and is not considered sufficient to assess the design of the dam. The Commonwealth did not recommend any changes when they reviewed the design.

2.2 Construction Data.

a. Data Available. Data available include correspondence between the Owner and the Commonwealth, construction inspection reports by the Commonwealth, and construction photographs. The only item that concerned one of the inspectors from the Commonwealth was the steepness of the upstream slope of the dam. A later inspection revealed that the slope was in accordance with the plans but that there was a berm added on the upstream slope. No construction data are available for subsequent modifications to the dam.

b. Construction Considerations. The available data raise no concerns about the original construction of the dam. There are concerns about subsequent modifications, which are addressed in Sections 5 and 6.

2.3 Operation. There are no formal records of operation. Records of inspections performed by the Commonwealth are available for the period from 1950 to 1955. A summary of the inspection reports is included in Appendix A.

2.4 Evaluation.

a. Availability. Engineering data were provided by the Bureau of Dams and Waterway Management, Department of Environmental Resources, Commonwealth of Pennsylvania (PennDER). The Owner was available for information during the visual inspection.

b. Adequacy. The type and amount of available design data and other engineering data are limited, and the assessment is based on the combination of available data, visual inspection, performance history, hydrologic and hydraulic assumptions, and calculations developed for this report.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The overall appearance of the dam and appurtenant structures is poor. Deficiencies were observed as noted below. A sketch of the dam with the locations of the deficiencies is presented on Exhibit B-1 in Appendix B. Survey information acquired for this Report is summarized in Appendix B. Datum used for the survey was the spillway crest, Elevation 737.1, as estimated from USGS contour mapping. On the day of the inspection, the pool elevation was 0.5 foot below the spillway crest level.

b. Embankment. The embankment is so overgrown that only the top of dam is fully visible (Photograph F). Mature trees and brush cover both slopes. There is minor erosion along the near-vertical upstream slope between the trees (Photograph H). The timber wall that retains the downstream edge of the top of the dam is bulged and offset in some places (Photographs F and G). There is some seepage through the riprap that extends along the toe of the dam between the spillway and the outlet works. None of the seepage was localized and all seeps were too small to estimate the flow, which intermingled with discharge from the spillway stoplog slot. There is seepage of 1 gpm that flows into an undrained, 25-foot square low area to the right of the outlet works.

The survey performed for this inspection revealed that there are low areas along the top of the dam and that the downstream slope, below the timber retaining wall, is 1V on 2H.

c. Appurtenant Structures. The outfall of the outlet works is at the junction of the spillway channel and the natural stream (Photograph E). The Owner was unaware that the outlet works existed. Just upstream of the outfall, the valve stem guide is lying on its side. The valve itself is below ground. No operating mechanism is evident.

The spillway is at the left abutment. The spillway is sketched in Appendix B. The original concrete weir, which is badly scoured, has been raised with concrete blocks (CMUs). There is a stoplog slot in the weir. A small quantity of water was leaking around the stoplogs. A wooden beam, of unknown purpose, spans the stoplog slot (Photograph B). The I-beams of the timber plank bridge are supported by CMU piers. The CMU piers did not appear to have any mortar (Photograph C). More than one-half of the spillway discharge channel immediately

downstream from the weir is covered with a fill that extends up to the elevation of the bridge deck (Photographs A, B, and C). This fill covers most of the left spillway wall, the upper part of which has been rebuilt with CMUs. The right spillway wall is severely scoured at some areas. The spillway channel extends downstream along the toe of the dam, which is protected by riprap. The channel is heavily overgrown (Photograph D).

d. Reservoir Area. According to USGS mapping, it appeared possible that there was a natural outlet at the upstream end of the reservoir. The Owner stated that there was no such outlet. Most of the watershed is wooded. The only development is minor and rural.

e. Downstream Conditions. The natural stream just downstream from the dam is quite overgrown. The stream then flows into a small pond. This pond is shown as a swamp on USGS mapping. Apparently, a small dam has been constructed at the outlet of the swamp. There is one dwelling adjacent to the outlet. From this outlet, the stream extends for 0.5 mile through a steep and narrow valley. Three dwellings are located within the floodplain at the downstream end of this reach. The stream then flows for 0.6 mile to a small dam adjacent to a sports camp. Access could not be gained to this site; however, as viewed from a nearby road, it was evident that the camp buildings, as well as other dwellings further upstream, were well above streambed. From the sports camp, the stream extends for 0.3 mile to Meadow Lake Dam and from there into an extensive swamp. Downstream conditions are further described in Section 5. It is possible that eight or more lives would be lost in the event of a failure of Pocono Highland Dam. Accordingly, a high hazard classification is warranted for Pocono Highland Dam.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at spillway crest with excess inflow discharging over the spillway. The Owner reported that the stoplogs in the notch at the spillway are removed to maintain structures around the lake and would be removed if a large flood was imminent. The outlet works is not used.

4.2 Maintenance of Dam. The dam is visited daily by a caretaker. The need for maintenance is determined by the Owner. Formal inspections of the dam are not made.

4.3 Maintenance of Operating Facilities. The outlet works is not maintained.

4.4 Warning Systems in Effect. There is no emergency warning system.

4.5 Evaluation of Operational Adequacy. The extent of the maintenance deficiencies described in Section 3 indicate that the maintenance of the dam and appurtenant works is inadequate. The frequency of inspection by the caretaker is good, but a program of formal annual inspections by a professional engineer is necessary to detect potentially hazardous conditions. Since intense storms can occur over small watersheds with little warning, removal of stoplogs is not considered a reliable method of increasing spillway capacity. A formalized emergency operation and warning system is necessary to reduce the risk of dam failure should adverse conditions develop and to prevent loss of life should the dam fail.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. The report upon the permit application for the construction of Pocono Highland Dam in 1927 indicated that the design capacity of the spillway was 635 cfs based on a spillway length of 35 feet and a maximum head of 3 feet. The dam was constructed with a spillway length of 33.9 feet. Photographs in the PennDER files indicate that the shape of the weir, as constructed, differed from the design drawing. Subsequently, the weir was raised by 1.3 feet and a spillway bridge with piers was constructed.

b. Experience Data. There are no known records of the maximum reservoir elevation at Pocono Highland Dam. The Owner reported that there was virtually no rise in pool during Tropical Storm Diane in 1955.

c. Visual Observations.

(1) General. The visual inspection of Pocono Highland Dam, which is described in Section 3, resulted in a number of observations relevant to hydrology and hydraulics. These observations are evaluated herein.

(2) Embankment. The low areas on the top of the dam reduce the spillway capacity to less than its design capacity.

(3) Appurtenant Structures. The outlet works is inoperable. The stoplog system in the spillway weir can only draw the pool down to 2.2 feet below spillway crest. Because the outlet works is inoperable, there is no means of drawing the pool down further in case of emergency.

The reason for the difference between the design length and the existing length of the spillway weir is unknown. Poor control during construction is a probable cause. The spillway bridge pier reduces the effective length of the weir. Since there is no mortar between the pier CMUs, the combination of vibration and hydrodynamic forces during a flood could cause the pier to fail. The spillway bridge could not then be relied upon to support vehicular loads. The fill that extends across the spillway outlet channel would also significantly reduce the spillway capacity, as would the timber beam above the stoplog slot. The underside of the existing spillway bridge has the potential to collect debris. The potential is small before overtopping of the dam occurs. The raising of the spillway crest made a very significant reduction in spillway capacity.

Although the riprap along the toe of the dam is in good condition, the dense growth in the spillway outlet channel reduces its discharge capacity considerably. The reduced discharge capacity could allow large spillway flows to overtop the riprap and flow along the unprotected embankment.

In the analysis described hereafter, the spillway weir has been modeled at its existing elevation and length, with a reduction to account for the spillway bridge pier. The effects of the timber over the spillway stoplog slot, of the fill downstream of the weir, and the potential effects of debris collecting at the spillway have been ignored. If these items were taken into consideration, the computed spillway capacity would have been considerably less. The slight increase in discharge capacity that could be provided if the stoplogs were removed has also been ignored.

(4) Reservoir Area. No conditions in the watershed or reservoir area were observed that might present a hazard to the dam.

(5) Downstream Conditions. Of the three dams downstream, two are small and considered of no significance. The third dam is Meadow Lake Dam and it was judged that it might be overtopped by a failure of Pocono Highland Dam. However, this would not increase the hazard to loss of life downstream from Meadow Lake Dam. There are four low-lying dwellings between Pocono Highland Dam and Meadow Lake Dam. Failure of Pocono Highland Dam would probably flood these four dwellings, with a probable loss of at least eight lives. Property damage would also occur. The downstream conditions indicate that a high hazard classification is warranted for Pocono Highland Dam.

d. Overtopping Potential.

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) for the size (small) and hazard potential (high) of Pocono Highland Dam is between one-half of the Probable Maximum Flood (PMF) and the PMF. Because the size of the dam is at the low end of the small size classification, the 1/2 PMF is selected as the SDF. The watershed and reservoir were modeled with the U.S. Army Corps of Engineers HEC-1DB computer program. A description of the model is included in Appendix D. The assessment of hydrology and hydraulics is based on existing conditions, and the effects of future development are not considered.

(2) Summary of Results. Pertinent results are tabulated at the end of Appendix D. The analysis reveals that the existing Pocono Highland Dam can pass about 6 percent of the PMF before overtopping of the dam occurs. During the 1/2 PMF, the dam would overtop by 1.4 feet for 13.3 hours. This would cause failure of the dam. The dam is rated at the previously noted minimum top of dam elevation. If the low areas on the top of the dam were filled to the design elevation, the spillway would pass about 11 percent of the PMF without any overtopping.

(3) Spillway Adequacy. The criteria used to rate the spillway adequacy of a dam are described in Appendix D. Because Pocono Highland Dam cannot pass the 1/2 PMF without failing, a failure analysis was performed. It was assumed that the dam would begin to fail during the 15 percent PMF. Assumptions used to model the failure are described in Appendix D. The resulting outflow was routed downstream. Failure of the dam during the 15 percent PMF would raise the water levels near dwellings up to 7.7 feet over levels that existed just prior to failure of the dam. A typical downstream section is shown in Appendix D. There is an increased hazard for loss of life. The spillway capacity of Pocono Highland Dam is rated as seriously inadequate. If the low areas on the dam were filled to the design elevation, the spillway capacity would still be rated as seriously inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of Pocono Highland Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for the various features.

(2) Embankment. The growth of trees and brush on or near the embankment is objectionable because it might obscure a hazardous condition. Another objection to the growth of trees is that the root systems can create seepage paths through the dam. The timber retaining wall at the top of the dam is not sufficiently sturdy to retain the earthfill and any imposed surcharge loadings. However, even if the wall were to fail completely, the embankment design template should remain intact. The wall is, therefore, not of concern. The fill that was used to widen the topwidth apparently covers the riprap on the upstream slope. Further erosion of the fill would only proceed until the riprap is uncovered. The only concern would be if the riprap were displaced by the trees growing on the slope.

The seepage at the embankment is not localized. Similar seepage has been reported in many of the periodic inspections by the Commonwealth. If the seepage does not change, the seepage is not of concern; however, it does warrant monitoring.

(3) Appurtenant Structures. No structural deficiencies were observed at the outlet works. An assessment of the spillway bridge piers was made in Section 5. The scour and cracking at the right spillway wall and weir indicate a need for repairs or replacement. Previous inspections by the Commonwealth noted that the left spillway wall had deteriorated severely by 1941. The fill that was placed in front of this wall may be helping to stabilize it. Its removal may affect the structural integrity of the wall.

b. Design and Construction Data. No stability analyses are available for the embankment. Available data raise no concerns for the stability of the embankment.

c. Operating Records. There are no formal records of operation. There is no evidence of stability problems over the operational history of the dam.

d. Post-construction Changes. Post-construction changes are described in Paragraph 1.2g. The changes have been assessed with the dam.

e. Seismic Stability. Pocono Highland Dam is located in Seismic Zone 1. Earthquake loadings are not considered to be significant for small dams located in Seismic Zone 1 when there are no readily apparent stability problems. Since there are no readily apparent stability problems, the ability of the embankment to withstand an earthquake is assumed to be adequate.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on available records, visual inspection, calculations, and past operational performance, Pocono Highland Dam is judged to be in poor condition. Based on the size and hazard classification of the dam, the recommended SDF at the dam varies between the 1/2 PMF and the PMF. The selected SDF is the 1/2 PMF. Based on existing conditions, the spillway will pass about 6 percent of the PMF before overtopping of the dam occurs. It is judged that the dam could not withstand the depth and duration of overtopping that would occur during storms greater than 15 percent of the PMF. Failure of Pocono Highland Dam would cause an increased hazard for loss of life downstream. The spillway capacity is rated as seriously inadequate. According to criteria established for these studies, the dam is judged to be unsafe, non-emergency, because the spillway capacity is seriously inadequate. If the low areas on the top of the dam were filled to the design elevation, the spillway would pass about 11 percent of the PMF without any overtopping. The spillway capacity would still be rated as seriously inadequate.

(2) A summary of features and observed deficiencies is as follows:

Feature	Observed Deficiency
Embankment:	Trees and brush on and near embankment slopes; low areas on embankment; minor erosion; minor seepage; wet area at toe of embankment.
Spillway:	Scour and cracking of concrete at weir and right wall; inadequate spillway pier construction; fill covering much of spillway outlet channel; overgrown spillway outlet channel.
Outlet Works:	Inoperable.

(b) Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as a part of this study.

(c) Urgency. The recommendations in Paragraph 7.2 should be implemented immediately.

(d) Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations by the Owner will be required.

7.2 Recommendations and Remedial Measures.

a. The following studies and remedial measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform additional studies to more accurately determine the spillway capacity required for Pocono Highland Dam as well as the nature and extent of measures required to provide adequate spillway capacity. Take appropriate action as necessary. If the existing spillway structure is utilized, repairs should be made to existing deteriorated concrete. Before studies are instituted, the spillway outlet channel should be cleared of trees, brush, and fill; in addition, the timber beam on the spillway crest should be removed and the low areas on the top of the dam filled to the design elevation to increase the spillway capacity during the design period.

(2) Remove brush and trees on or near the embankment.

(3) Institute any necessary repairs to make the outlet works operational. In addition, develop a plan to provide upstream closure for the outlet works in case of an emergency.

(4) Visually monitor the seepage areas, the wet area, and the erosion on the upstream slope. Take appropriate action if any condition worsens.

All investigations, studies, designs, and construction inspection should be performed by a professional engineer experienced in the design and construction of dams. Tree removal and removal of fill by the left spillway wall should also be guided by a professional engineer.

b. In addition, the Owner should institute the following operational and maintenance procedures.

(1) Develop a detailed emergency operation and warning system for Pocono Highland Dam. When warnings of a major storm are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

(2) During periods of unusually heavy rains, provide round-the-clock surveillance of the dam.

(3) As presently required by the Commonwealth, initiate a program of formal annual inspections by a professional engineer experienced in the design and construction of dams. Utilize the inspection results to determine if remedial measures are necessary.

(4) Institute a maintenance program and develop a formal maintenance manual so that all features of the dam are properly maintained.

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: Pocono Highland

NDI ID NO.: PA-00992 DER ID NO.: 45-131

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	See Plate E-2
REGIONAL VICINITY MAP	See Plate E-1
CONSTRUCTION HISTORY	Built 1927-1928
TYPICAL SECTIONS OF DAM	See Plate E-2
OUTLETS: Plan Details Constraints Discharge Ratings	See Plate E-2

A-1

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None
DESIGN REPORTS	Analysis of Design by Pennsylvania Water Supply Commission
GEOLOGY REPORTS	None
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	See "Design Reports" above.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	None
POSTCONSTRUCTION SURVEYS OF DAM	None

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	Reservoir Area
MONITORING SYSTEMS	None
MODIFICATIONS	Spillway crest raised Topwidth of dam widened Bridge across spillway added
HIGH POOL RECORDS	None
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	None

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	NONE
SPILLWAY: Plan Sections Details	See PLATE E-2
OPERATING EQUIPMENT: Plans Details	See PLATE E-2
PREVIOUS INSPECTIONS Dates Deficiencies	1928 (POST-CONSTRUCTION) STEEL PINS ON SPILLWAY CREST. SMALL FLOW OF WATER AT TOE 100' RIGHT OF SPILLWAY. SMALL AMOUNT FILL NEEDED behind "The ABUTMENTS". 1929 - LEAKAGE ALONG TOE AT VARIOUS POINTS TO RIGHT OF OLD STREAM CHANNEL. NO WELL-DEFINED SPILLWAY OUTLET CHANNEL. GOOD CONDITION
(CONTINUED)	1931 - "Appeared TO be AT LEAST TWO LEAKS TOWARD RIGHT END"; TWO SETS OF FISH SCREENS; The ONE UNDER The BRIDGE IS FIRMLY BRACED. STILL NO WELL-DEFINED SPILLWAY OUTLET CHANNEL.

A-4

ENGINEERING DATA **Sheet 4a of 4**

ITEM	REMARKS
Previous Inspections (continued)	1934 - Brush on dam; light fish screen on spillway; seepage under embankment along right end. Small flows out of "waste paving".
	1937 - Ownership changed. Brush on dam. Light fish screen on spillway. Left spillway abutment deteriorating. Swampy at lower toe. Seepage flair toe along right end.
	1941 - Brush on dam. Fish screen obstructs flow. Toe is wet and swampy between blowoff and right hillside. Left spillway abutment very badly disintegrated
	1948 - Overgrown with brush up to 7' high. Embankment low at abutments. Spillway outlet channel obstructed by drift and brush. Considerable leakage 125' right of spillway. Some leakage at blow-off pipe. Swampy area 25' right of blow is 25' long. "Bridge bent & fish screen closing entire spillway."
	1949 - Small trees on downstream slope. Small flow through half clogged fish screen. Considerable leakage at toe 125' right of spillway and some at outlet pipe. Swampy to right of blowoff pipe. Brush at toe.
	1966 - Trees and brush on slopes. Spillway crest [illegible] cinder block. Spillway outlet channel "half covered with fill."

A-5

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: Pocono Highland **County:** Monroe **State:** Pennsylvania

NDI ID No.: PA-00992 **DER ID No.:** 45-131

Type of Dam: Earthfill **Hazard Category:** High

Date(s) Inspection: 1 June 1981 **Weather:** Clear **Temperature:** 70's °F

Soil Conditions: Moist

Pool Elevation at Time of Inspection: 736.6 **msl/Tailwater at Time of Inspection:** 718.4 **msl**

Inspection Personnel:

Mrs. M. Weinberg (Pocono Highlands)

D. Wilson (GFCC)

D. Eberesole (GFCC)

A. Whitman (GFCC) **Recorder**

a-1

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NONE	
SLOUGHING OR EROSION: **Embankment Slopes** **Abutment Slopes**	TIMBERS RETAINING TOP ARE BULGED IN AREAS.	
CREST ALIGNMENT: **Vertical** **Horizontal**	VERTICAL - SEE PROFILE FOLLOWING INSPECTION FORM. HORIZONTAL - OK EXCEPT AS NOTED ABOVE	
RIPRAP FAILURES	RIPRAP IS SUBMERGED.	

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: **Abutment** **Spillway** **Other Features**	No deficiencies.	Shale outcrops at right abutment.
ANY NOTICEABLE SEEPAGE	See Exhibit B-1 Small amount seepage along toe to left of outlet works. 1 gpm into wet area right of outlet.	
STAFF GAGE AND RECORDER	None at Site	
DRAINS	None	
Vegetation	Mature trees on upstream slope. Mature trees and brush on downstream slope.	

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	12" DIAMETER CAST IRON PIPE (CIP).	
INTAKE STRUCTURE	Submerged	
OUTLET STRUCTURE	FREE OUTFALL	
OUTLET CHANNEL	NATURAL STREAM	
EMERGENCY GATE	VALVE AT DOWNSTREAM TOE VALVE STEM GUIDE IS LYING ON ITS SIDE.	OWNER UNAWARE OF EXISTENCE OF OUTLET PIPE.

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Severe scour on original weir. 16" concrete blocks (CMU) on top of original weir.	
APPROACH CHANNEL	Reservoir.	
DISCHARGE CHANNEL	Scour at toe of right retaining wall. Fill covers left side of channel at weir.	Channel extends along toe of embankment, which has stone protection. Channel is heavily overgrown
BRIDGE AND PIERS	Bridge is in good condition. Piers are CMU - mortar not apparent & foundation of downstream pier uncertain.	

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE AT SITE	
OBSERVATION WELLS		
WEIRS		
PIEZOMETERS		
OTHER	NONE AT SITE	

DOWNSTREAM CHANNEL

Sheet 1 of 1

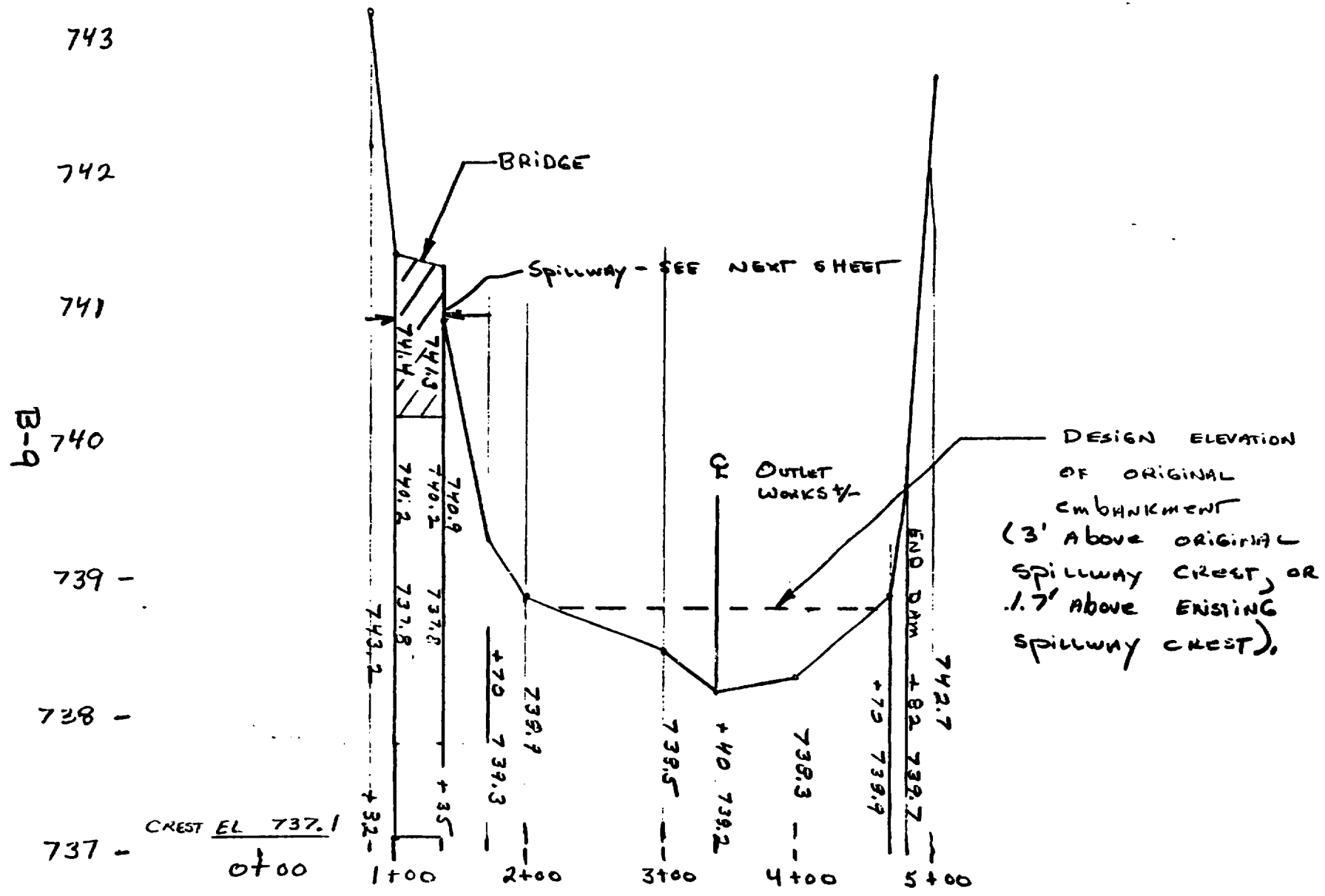
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: **Obstructions** **Debris** **Other**	AT dam - OVERGROWN	
SLOPES	RELATIVELY MILD AT DAMSITE	
APPROXIMATE NUMBER OF HOMES AND POPULATION	4 dwellings	ALSO 3 dams DOWNSTREAM. ONLY 1 IS OF SIGNIFICANT SIZE. See PLATE E-1

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	VARIES - FLAT SWAMPS TO STEEP HILLSIDES.	
SEDIMENTATION	NO REPORTED OR OBSERVED PROBLEMS.	
WATERSHED DESCRIPTION	MOSTLY WOODED. MINOR RURAL DEVELOPMENT.	

E-08

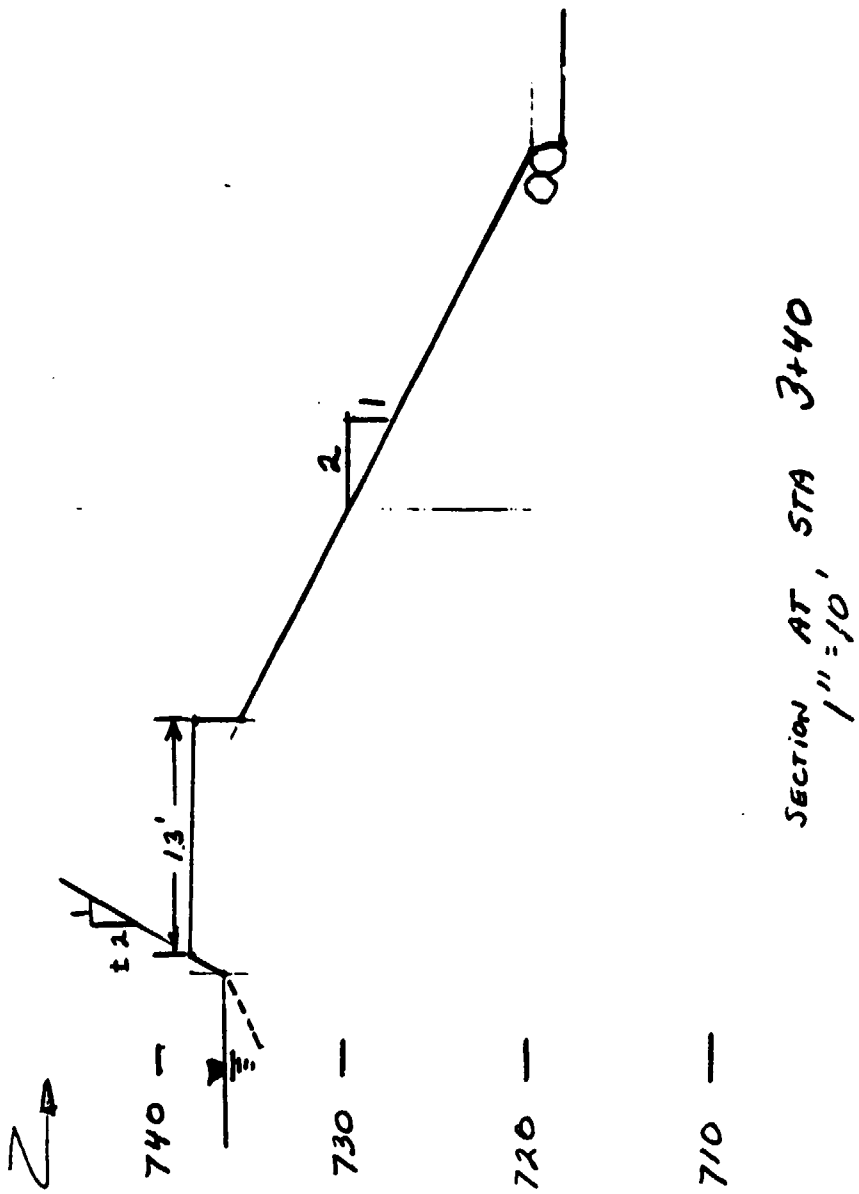


PROFILE - LOOKING DOWNSTREAM

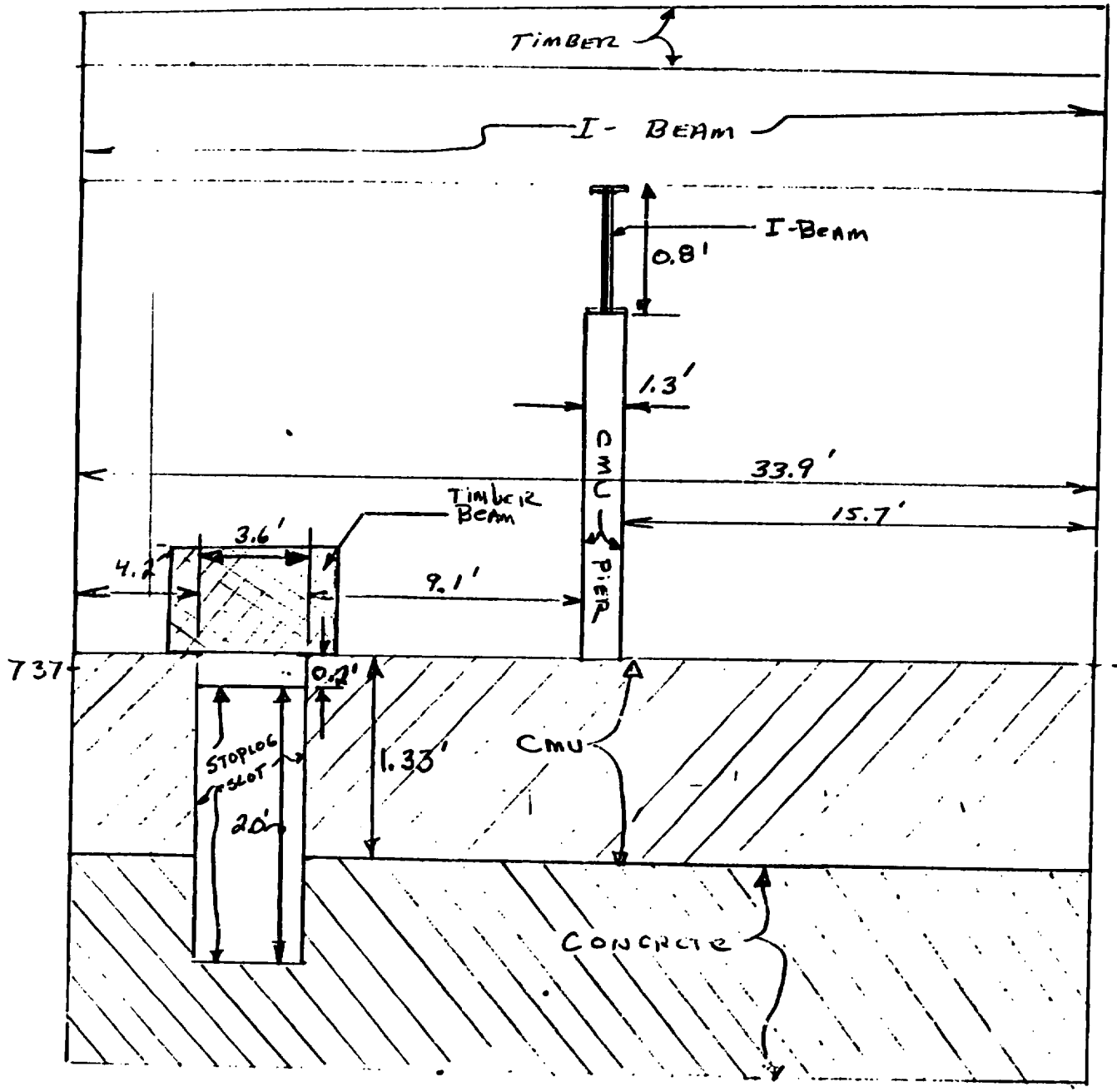
BY _____ DATE _____
CHKD. BY _____ DATE _____
SUBJECT POCONO HIGHLAND
SHEET NO. _____ OF _____
JOB NO. _____

BY _____ DATE _____ SUBJECT Pocono Highland SHEET NO. _____ OF _____

CHKD. BY _____ JOB. NO. _____



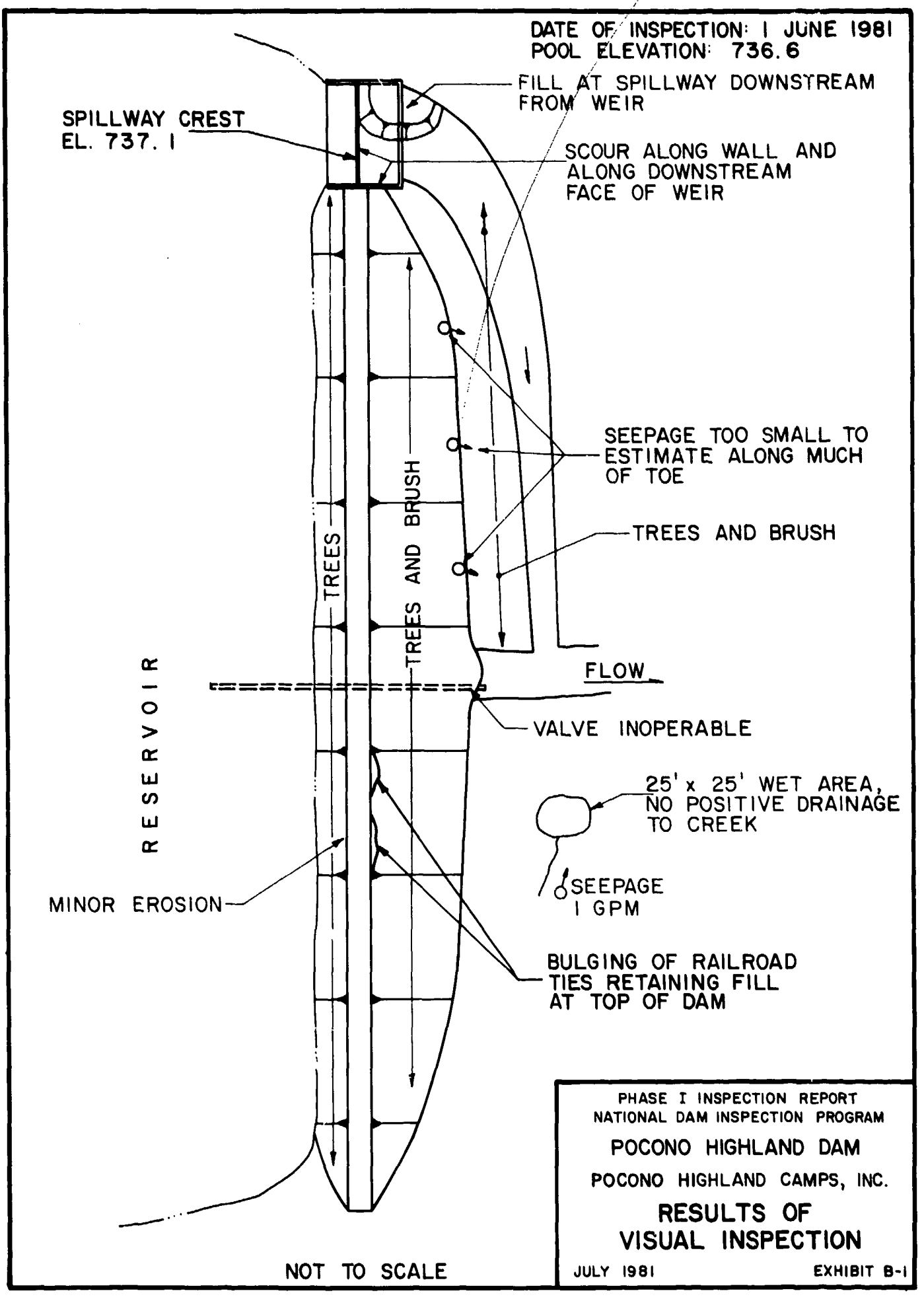
SECTION AT STA 3+40
1" = 10'



B-11

Spillway
LOOKING upstream
SCALES
VERT 1" = 1'
HORIZ 1" = 5'

BY _____ DATE _____
CHKD BY _____ DATE _____
SUBJECT POCONO HIGHLAND
SHEET NO. _____ OF _____
JOB NO. _____



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

POCONO HIGHLAND DAM

POCONO HIGHLAND CAMPS, INC.

RESULTS OF VISUAL INSPECTION

JULY 1981 EXHIBIT B-1

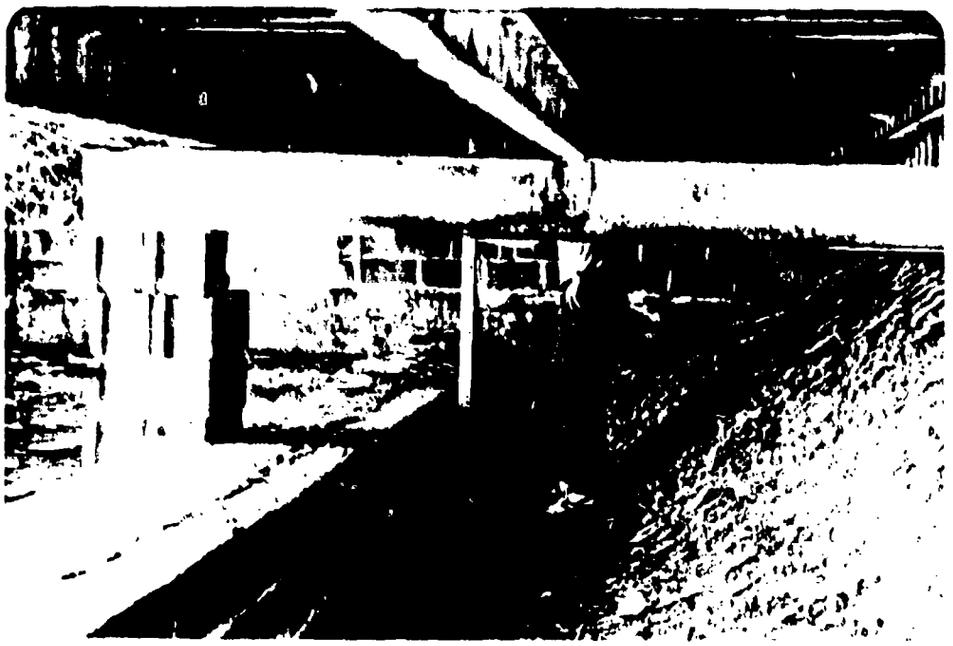
APPENDIX C

PHOTOGRAPHS

POCONO HIGHLAND DAM

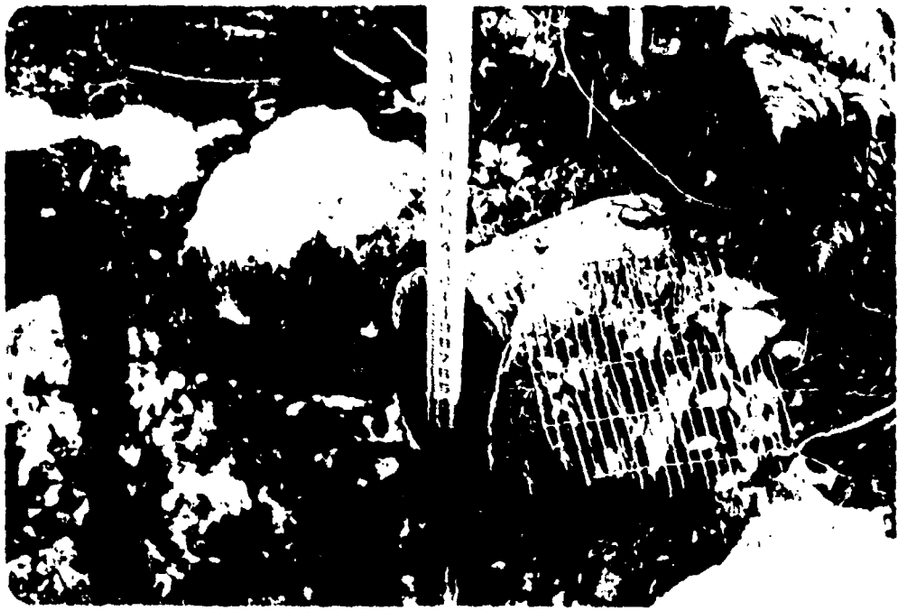
A. View from Left Abutment

B. Spillway



C. Spillway Weir

D. Spillway Outlet Channel

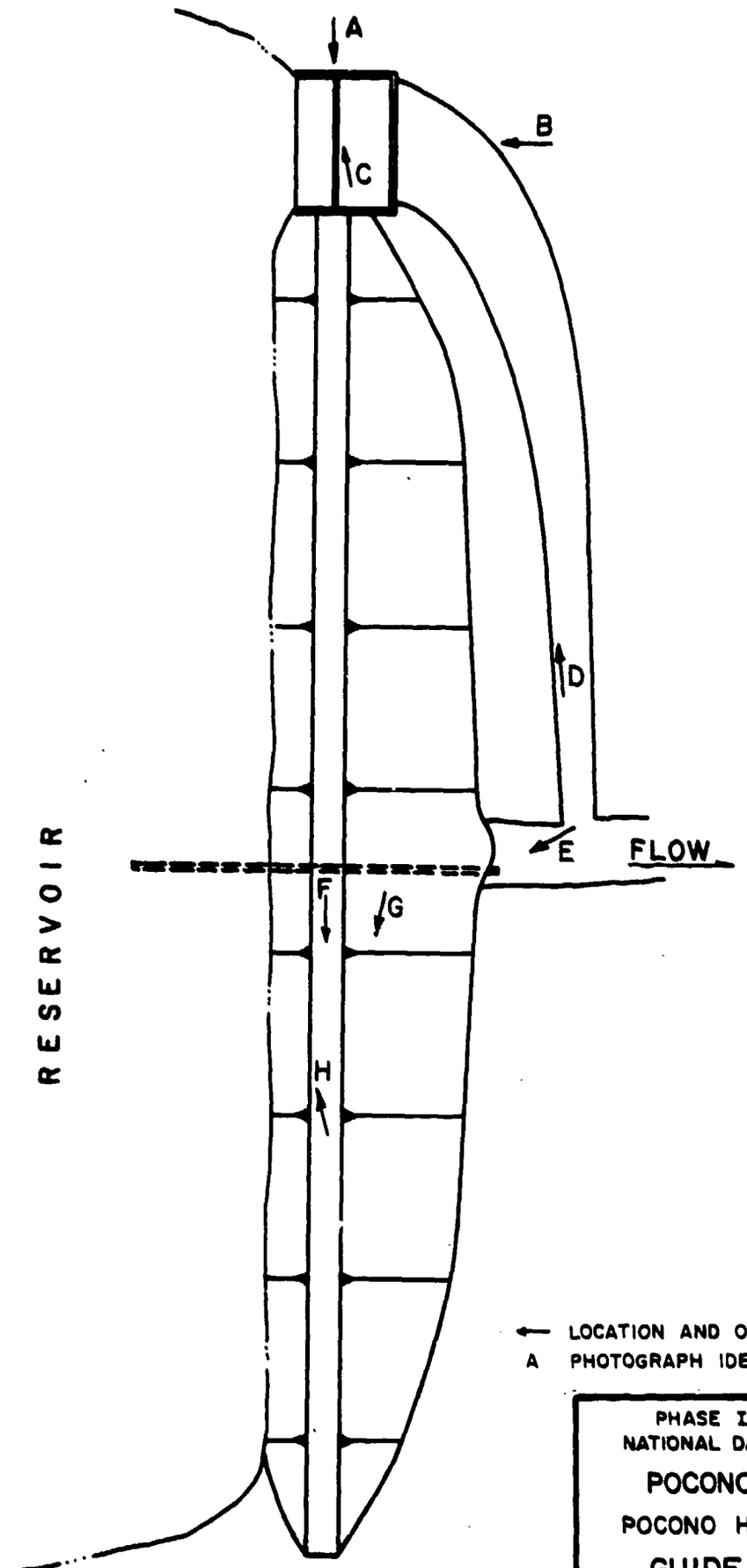


E. Outfall of Outlet Works

F. Top of Dam

G. Downstream Slope

H. Upstream Slope



← LOCATION AND ORIENTATION OF CAMERA

A PHOTOGRAPH IDENTIFICATION LETTER

NOT TO SCALE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

POCONO HIGHLAND DAM

POCONO HIGHLAND CAMPS, INC.

GUIDE TO LOCATION OF PHOTOGRAPHS

JULY 1981 EXHIBIT C-1

APPENDIX D

HYDROLOGY AND HYDRAULICS

APPENDIX D

HYDROLOGY AND HYDRAULICS

Spillway Capacity Rating:

In the recommended Guidelines for Safety Inspection of Dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended Spillway Design Flood (SDF) for the size (small, intermediate, or large) and hazard potential (low, significant, or high) classification of a dam is selected in accordance with the criteria. The SDF for those dams in the high hazard category varies between one-half of the Probable Maximum Flood (PMF) and the PMF. If the dam and spillway are not capable of passing the SDF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, or if the dam is not in the high hazard category, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

Description of Model:

If the Owner has not developed a PMF for the dam, the watershed is modeled with the HEC-1DB computer program, which was developed by the U.S. Army Corps of Engineers. The HEC-1DB computer program calculates a PMF runoff hydrograph (and percentages thereof) and routes the flows through both reservoirs and stream sections. In addition, it has the capability to simulate an overtopping dam failure. By modifying the rainfall criteria, it is also possible to model the 100-year flood with the program.

APPENDIX D

Delaware River Basin
Name of Stream: [illegible]
Name of Dam: POCONO HIGHLAND
NDI ID No.: PA-00992
DER ID No.: 45-131
Latitude: N 41°04.4' Longitude: W 75°06.5'
Top of Dam Elevation: 739.2
Streambed Elevation: 718.0 Height of Dam: 22.2 ft
Reservoir Storage at Top of Dam Elevation: 114 acre-ft
Size Category: SMALL
Hazard Category: HIGH (see Section 5)
Spillway Design Flood: [illegible] PMF
[illegible] 1/2 PMF

UPSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
— NONE —				

DOWNSTREAM DAMS

SMALL DAM	0.5	3+/-	NOT CLOSELY OBSERVED.	BACKS WATER UP INTO UPSTREAM SWAMP
SMALL DAM	1.6	NOT	OBSERVED	
[illegible] LAKE	1.9	14	61	DER 45-47

DELAWARE River Basin

Name of Stream: SPRING RUN

Name of Dam: POCONO HIGHLANDS

DETERMINATION OF PMF RAINFALL & UNIT HYDROGRAPH

UNIT HYDROGRAPH DATA:

Sub-area	Drainage Area (square miles)	Cp (1)	Ct (2)	L miles (3)	L_{ca} miles (4)	L' miles (5)	Tp hours (6)	Map Area (7)	Plate (8)
A	1.13	0.45	1.23	1.59	.75	N/A	1.31	1	A
Total	1.13								

(See Sketch on Sheet D-4)

(1) & (2): Snyder Unit Hydrograph coefficients supplied by Baltimore District, Corps of Engineers on maps and plates referenced in (7) & (8)

The following are measured from the outlet of the subarea:

(3): Length of main watercourse extended to divide

(4): Length of main watercourse to the centroid

The following is measured from the upstream end of the reservoir at normal pool:

(5): Length of main watercourse extended to divide

(6): $Tp=C_t \times (L \times L_{ca})^{0.3}$, except where the centroid of the subarea is located in the reservoir. Then $Tp=C_t \times (L')^{0.6}$

Initial flow is assumed at 1.5 cfs/sq. mile

Computer Data: QRCSN = -0.05 (5% of peak flow)
RTIOR = 2.0

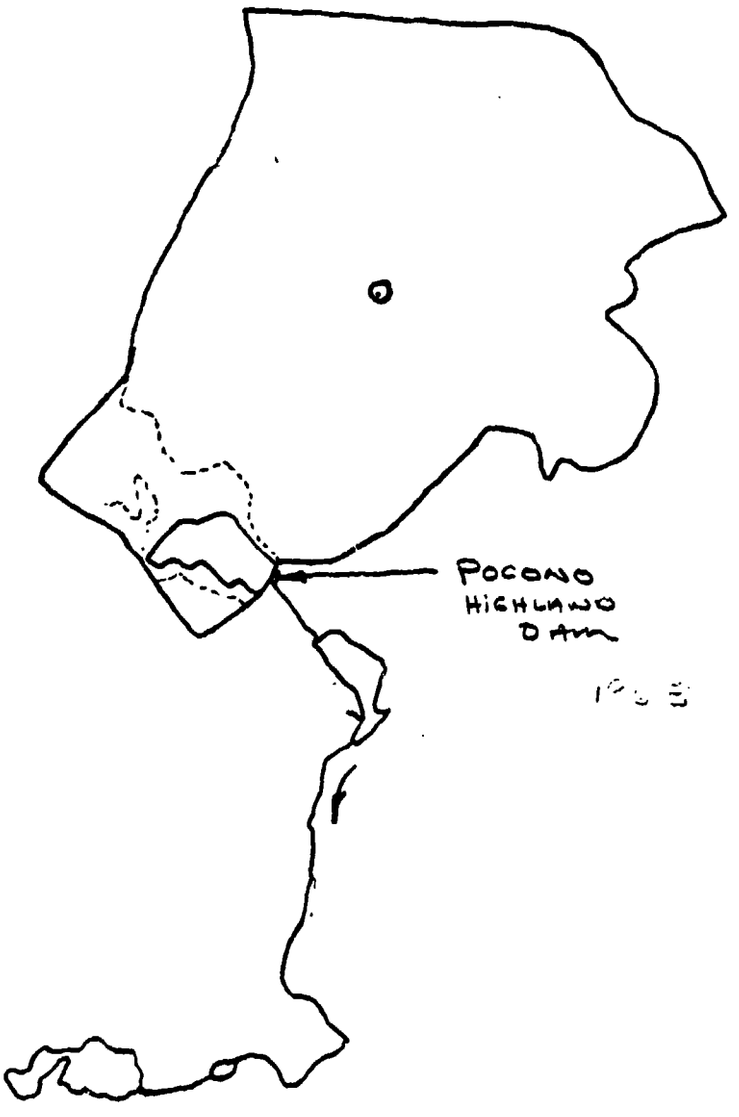
RAINFALL DATA:

PMF Rainfall Index= 22.1 in., 24 hr., 200 sq. mile

	Hydromet. 40 (Susquehanna Basin)	Hydromet. 33 (Other Basins)
Zone:	N/A	1
Geographic Adjustment Factor:	N/A	1.0
Revised Index Rainfall:	N/A	22.1

RAINFALL DISTRIBUTION (percent)

Time	Percent
6 hours	111
12 hours	123
24 hours	133
48 hours	142
72 hours	N/A
96 hours	N/A



SKETCH OF SYSTEM

Data for Dam at Outlet of Subarea A (See sketch on Sheet D-4)

Name of Dam: Pocono Manor

STORAGE DATA:

Elevation		Area (acres)		Storage million gals	Storage acre-ft		Remarks
719.0	=ELEV0*	0		0	0		INVERT O.U.
735.8	=ELEV1	12	=A1		71	=S1	PLATE EL.
737.1		15.4			89		[illegible] USGS
738.2		20			114		TOP DAM
735.8		40			135		
740.0		65					

* ELEV0 = ELEV1 - $(3S_1/A_1)$

** Planimetered contour ~~at least 10 feet~~ above top of dam

Reservoir Area at Normal Pool is 2 percent of subarea watershed.

BREACH DATA:

See Appendix B for sections and existing profile of the dam.

Soil Type from Visual Inspection: SILT & SAND

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) 3.0 fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) & A = L·depth

HMAX = $(4/9\ V^2/C^2)$ = 0.5 ft., C = 2.7 Top of Dam El.= 738.2

HMAX + Top of Dam El. = 738.7 = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = 80 ft (width of bottom of breach)
Z = 1 (side slopes of breach)
ELBM = 719.0 (bottom of breach elevation, minimum of zero storage elevation)
WSEL = 735.8 (normal pool elevation)
T FAIL= 6 mins = 0.1 hrs (time for breach to develop)

Data for Dam at Outlet of Subarea A

Name of Dam: POCONO HIGHLANDS

SPILLWAY DATA: $Q = CLH^{1.5}$

	Existing † Conditions	Design * Conditions
Top of Dam Elevation	738.2	738.8
Spillway Crest Elevation	737.1	735.8
Spillway Head Available (ft)	1.1	3.0
Type Spillway	BROAD CRESTED	WEIR
"C" Value - Spillway	2.7	3.1
Crest Length - Spillway (ft)	32.6	35.0
Spillway Peak Discharge (cfs)	102	564
Auxiliary Spillway Crest Elev.		
Auxiliary Spill. Head Avail. (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spill. (ft)		
Crest Length - Auxil. Spill. (ft)		
Auxiliary Spillway Peak Discharge (cfs)		
Combined Spillway Discharge (cfs)	102	564

* AS CONSTRUCTED MAY VARY SLIGHTLY

Spillway Rating Curve:

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)

OUTLET WORKS RATING:

	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet	718.0		
Invert of Inlet			
Type	CIP		
Diameter (ft) = D	1.0		
Length (ft) = L	95		
Area (sq. ft) = A	0.79		
N	0.014		
K Entrance	0.5		
K Exit	1.0		
K Friction $=29.1N^2L/R^{4/3}$	3.44		
Sum of K	4.94		
$(1/K)^{0.5} = C$	0.45		
Maximum Head (ft) = HM	18+/-		
$Q = CA\sqrt{2g(HM)}$ (cfs)	12		
Q Combined (cfs)	12		

† EXCLUSIVE OF BERM ALONG PART OF CREST OR FILL AT LEFT SIDE OF SPILLWAY, WORK OF WHICH WOULD REDUCE THE CAPACITY.

BY _____ DATE _____ SUBJECT _____ SHEET NO. _____ OF _____

CHKD. BY _____ DATE _____ JOB. NO. _____

Selected Computer Output

```
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
     1                A1                                  NATIONAL DAM INSPECTION PROGRAM
     2                A2                                            SPRING RUN
     3                A3                                      POCONO HIGHLAND DAM
     4                B    300       0      15       0       0       0       0       0      -4       0
     5                B1     5
     6                J      1       7       1
     7                J1     1      .5      .4      .3      .2      .1     .05
     8                K      0       1                                      1
     9                K1       INFLOW TO POCONO HIGHLAND DAM
    10                M      1       1   1.13            1.13                                   1
    11                P              22.1     111     123     133     142
    12                T                                                      1     .05              .02
    13                W   1.31     .45
    14                X   -1.5    -.05     2.0
    15                K      1       1                                      1
    16                K1       ROUTE THROUGH DAM
    17                Y                                       1       1
    18                Y1     1                                              -737.1
    19                SA     0      12    15.6      65
    20                SE   718   735.8   737.1     740
    21                SS 737.1    32.6     2.7     1.5
    22                SD 738.2
    23                SL     0      70     120     270     305     335
    24                SV 738.2   738.3   738.5   738.9   739.3   740.2
    25                K     99
```

D-08

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS						
				RATIO 1 1.00	RATIO 2 .50	RATIO 3 .40	RATIO 4 .30	RATIO 5 .20	RATIO 6 .10	RATIO 7 .05
HYDROGRAPH AT	1	1.13	1	2865.	1422.	1138.	853.	569.	284.	142.
	(	2.93)	(	80.55)(	40.27)(	32.22)(	24.16)(	16.11)(	8.05)(	4.03)(
ROUTED TO	1	1.13	1	2709.	1349.	1075.	799.	519.	227.	95.
	(	2.93)	(	76.71)(	38.20)(	30.44)(	22.62)(	14.69)(	6.44)(	2.68)(

SUMMARY OF DAM SAFETY ANALYSIS

POCONO HIGHLAND DAM

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	737.10	737.10	738.20
STORAGE	89.	89.	116.
OUTFLOW	0.	0.	102.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	740.32	2.12	219.	2709.	19.25	41.50	0.00
.50	739.61	1.41	174.	1349.	13.25	41.50	0.00
.40	739.44	1.24	164.	1075.	12.25	41.50	0.00
.30	739.24	1.04	154.	799.	11.00	41.50	0.00
.20	739.00	.80	143.	519.	9.00	41.75	0.00
.10	738.61	.41	127.	227.	5.75	42.50	0.00
.05	738.15	0.00	112.	95.	0.00	43.00	0.00

D-10

A

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  01 APR 80
**********
```

NATIONAL DAM INSPECTION PROGRAM
SPRING RUN
POCONO HIGHLAND DAM

```
A1
A2
A3
B    300        0        6        0        0        0        0        0       -6        0
B1     5
J      2        2        1
J1    .5      .15                                                    1
K      0        1
K1
INFLOW TO POCONO HIGHLAND DAM
N      1        1     1.13                 1.13                                        1
P              22.1      111      123      133                       1      .05              .02
T
U   1.31      .65
X   -1.5     -.05      2.0                                           1
K      1        1
K1
ROUTE THROUGH DAM
Y                                   1        1                      -737.1
Y1     1
SA     0       12     15.4       65
SE   718    735.8    737.1      740
SS 737.1     32.6      2.7      1.5
SD 738.2
SL     0       70      120      270      305      335
SV 738.2    738.3    738.5    738.9    739.3    740.2
SB    80        1      718      0.1    735.8    750.0
SB    80        1      718      0.1    735.8    738.7                  1
K      1        2
K1
ROUTE-FIRST REACH
Y                                   1        1                        -1
Y1     1
Y6   .09      .06      .09      700      720     2500     .012
Y7     0      760      650      740      760      720      850      700     1350      700
Y7  1550      720     2100      760     2150      760
K      1        3                                                     -1
K1
ROUTE 2ND REACH-DAMAGE CENTER
Y                                   1        1                        -1
Y1     1
Y6   .20      .07      .09      600      610     2500      .05
Y7     0      620      100      610      296      604      300      600      315      600
Y7   325      610      350      610      390      620
K     99
```

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .50	RATIO 2 .15
HYDROGRAPH AT	1	1.13 (2.93)	1	1422. (40.26)	427. (12.08)
			2	1622. (40.26)	627. (12.08)
ROUTED TO	1	1.13 (2.93)	1	1362. (37.99)	361. (10.21)
			2	22246. (629.94)	22081. (625.25)
ROUTED TO	2	1.13 (2.93)	1	1324. (37.49)	357. (10.11)
			2	10127. (286.77)	9972. (282.39)
ROUTED TO	3	1.13 (2.93)	1	1327. (37.63)	357. (10.11)
				6538. (185.15)	6423. (181.89)

RATIOS APPLIED TO FLOWS

PLAN 1
NO DAM BREACH

PLAN 2
DAM BREACH

D-12

SUMMARY OF DAM SAFETY ANALYSIS

POCONO HIGHLAND DAM

PLAN 1 ..No..Dam..Breach

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	735.80	737.10	738.20
STORAGE	71.	89.	114.
OUTFLOW	0.	0.	102.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	739.61	1.41	174.	1362.	12.50	17.60	0.00
.15	738.82	.62	136.	361.	7.10	18.10	0.00

PLAN 2 ..Dam..Breach

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	735.80	737.10	738.20
STORAGE	71.	89.	114.
OUTFLOW	0.	0.	102.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	738.74	.54	132.	22246.	1.07	14.70	14.60
.15	739.72	.52	132.	22041.	1.17	17.20	17.10

D-13

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	1724.	700.9	17.70
.15	357.	700.3	18.40

PLAN 2 STATION 2

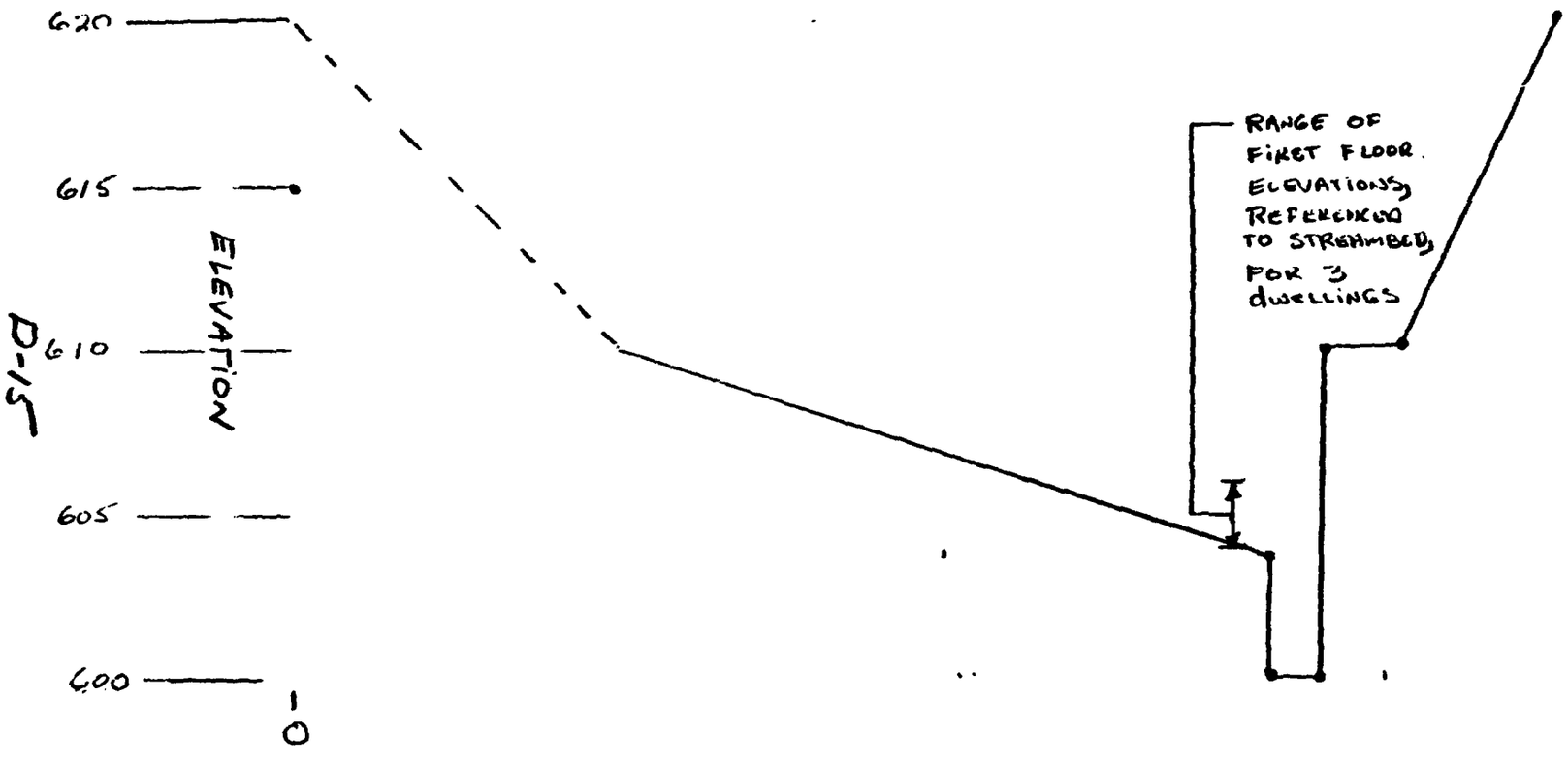
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	10127.	703.3	14.80
.15	9972.	703.3	17.30

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	1722.	615.4	17.50
.15	357.	602.6	18.40

PLAN 2 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	6539.	610.4	14.90
.15	6423.	610.3	17.40



D-15

Approximate Cross Section At Drainage Center

SCALES: HORIZ - 1" = 50'
VERT - 1" = 5'

BY _____ DATE _____ SUBJECT _____
CHKD BY _____ DATE _____
SHEET NO. _____ OF _____
JOB. NO. _____

BY _____ DATE _____ SUBJECT _____ SHEET NO. _____ OF _____
CHKD. BY _____ DATE _____ JOB. NO. _____

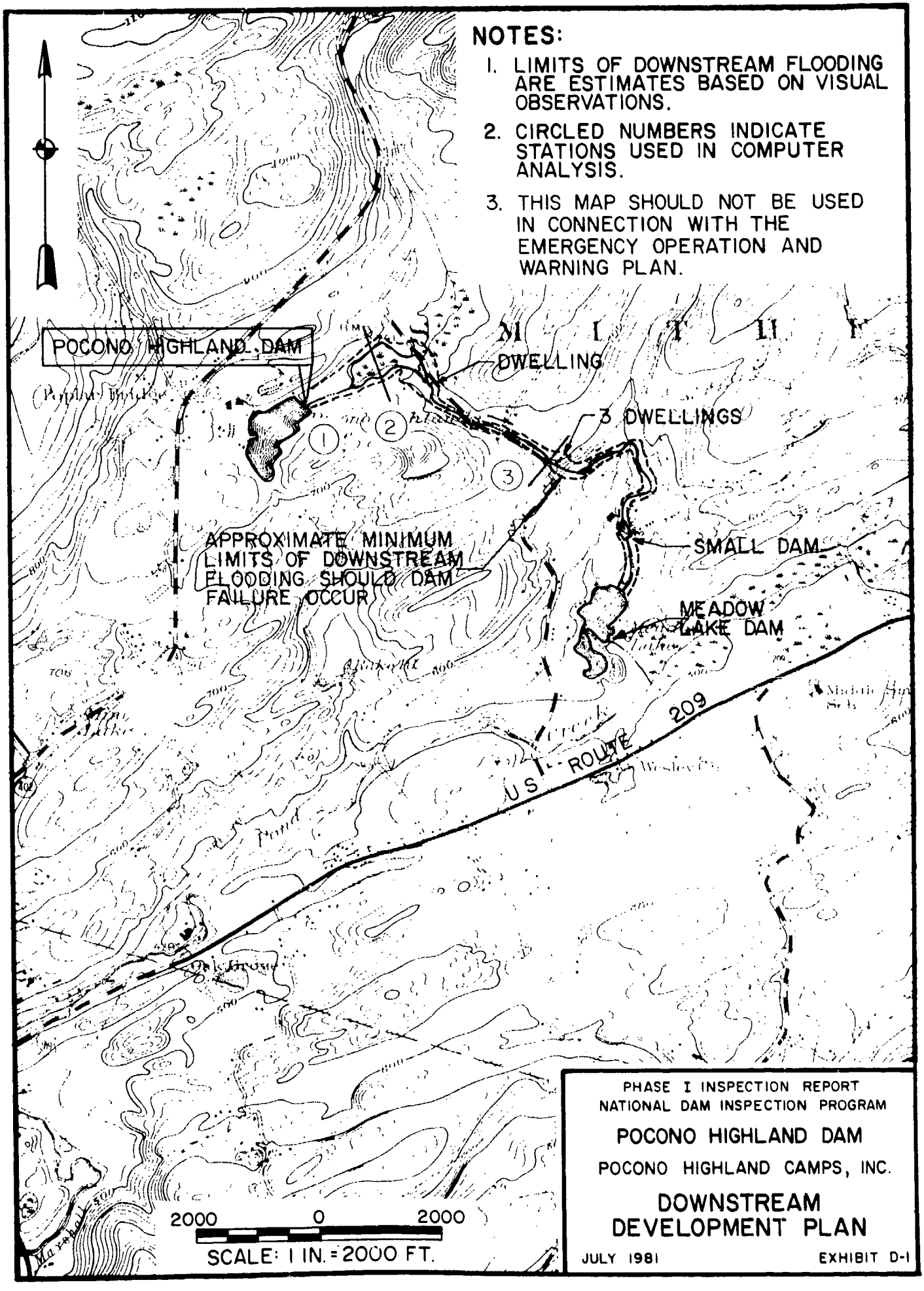
Summary of Pertinent Results
Pocono Highland Dam

	PMF	½ PMF = SDF
Rainfall (inches)	25.11	—
Runoff (inches)	22.76	11.38
Peak Inflow (cfs)	2845	1422
Peak Outflow (cfs)	2709	1349
Depth of Overtopping (ft)	2.12	1.41
Duration of Overtopping (hrs)	19.25	13.25

From Breach Analysis

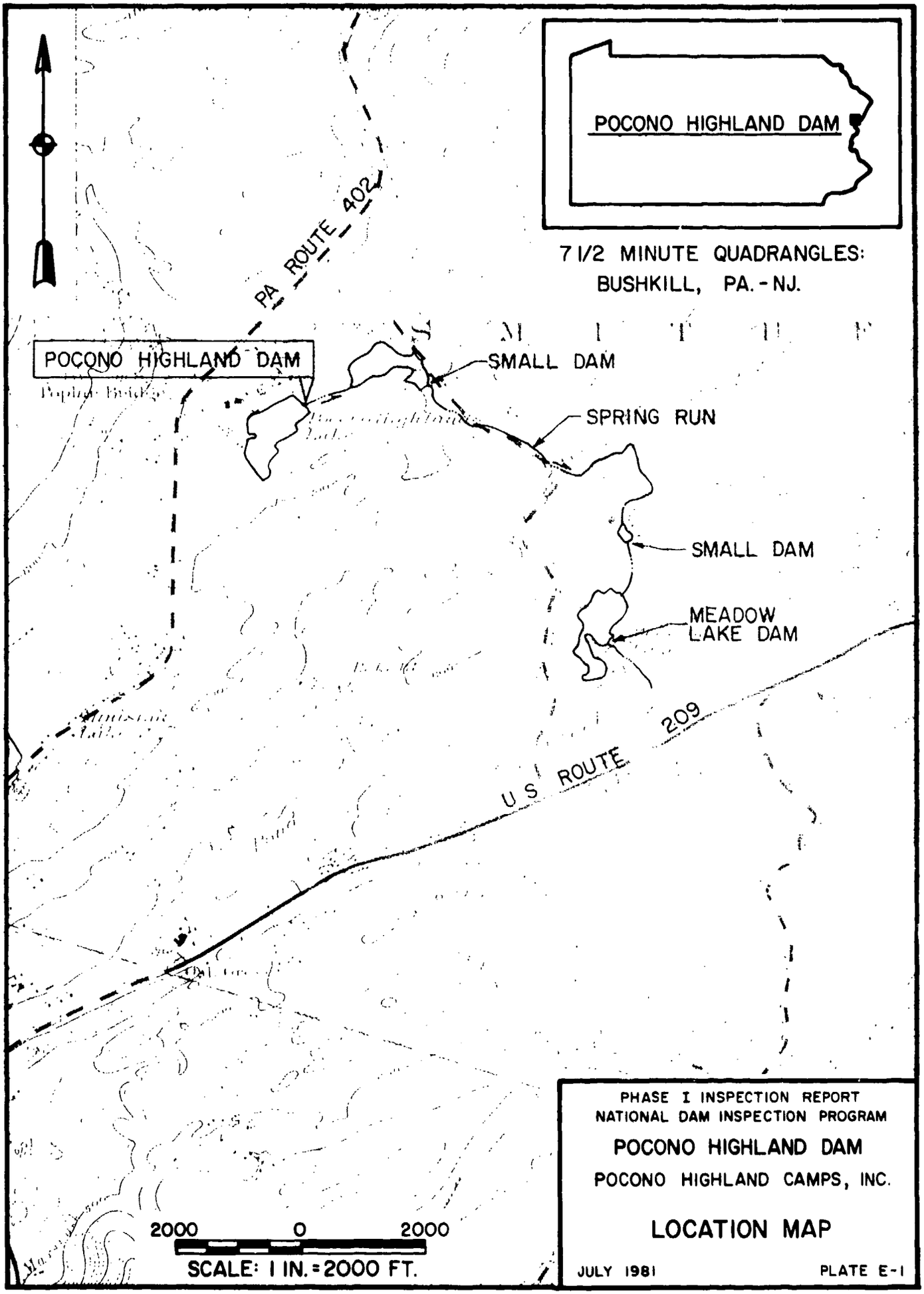
	½ PMF	15% PMF
Peak Outflow (cfs)	22,246	22,081
Water Surface at Damage Center*		
with dam breach (Elev)	610.4	610.3
without dam breach (Elev)	605.4	602.6
Difference (ft)	5.0	7.7

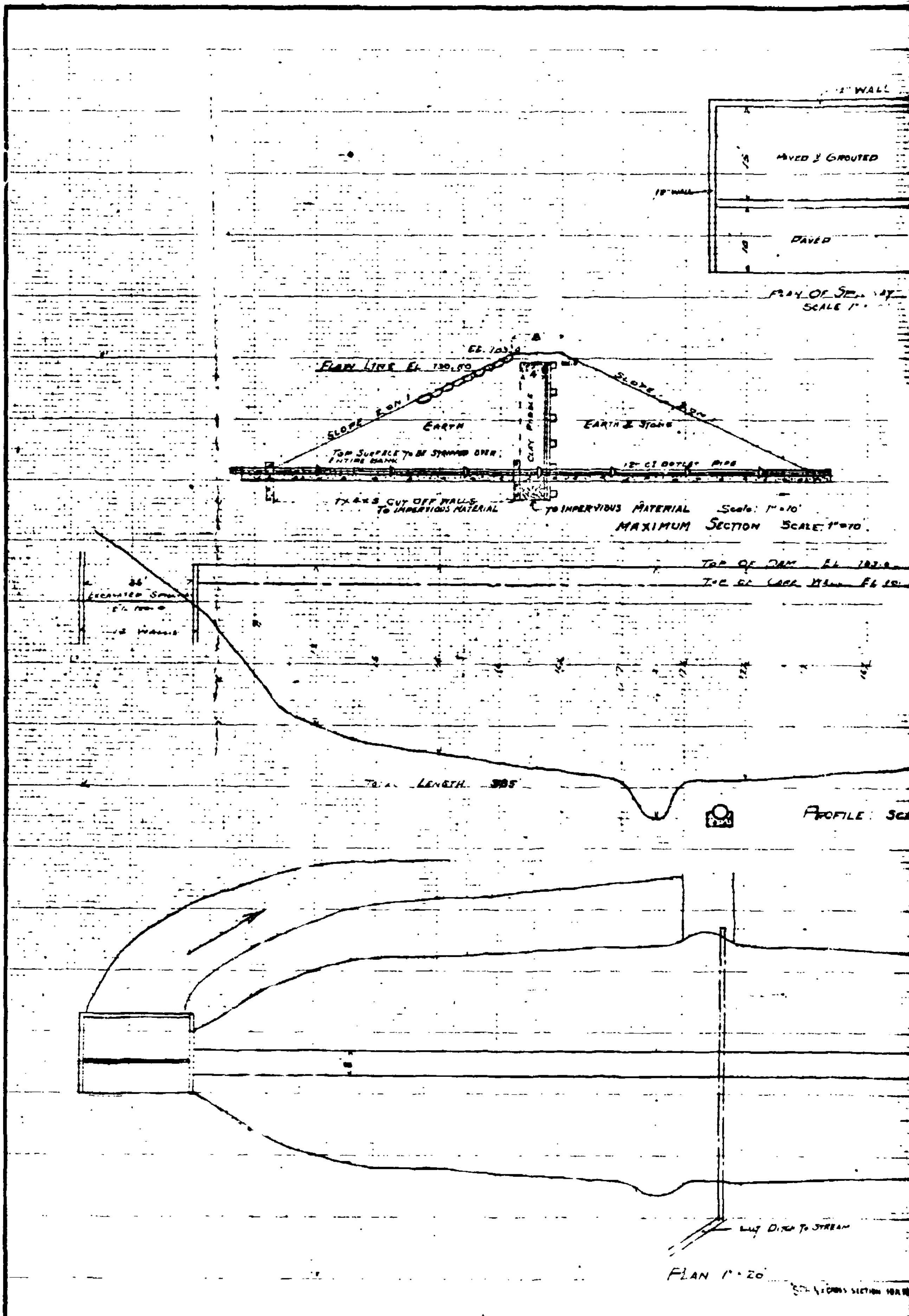
* See section on previous sheet


NOTES:
1. LIMITS OF DOWNSTREAM FLOODING ARE ESTIMATES BASED ON VISUAL OBSERVATIONS.
2. CIRCLED NUMBERS INDICATE STATIONS USED IN COMPUTER ANALYSIS.
3. THIS MAP SHOULD NOT BE USED IN CONNECTION WITH THE EMERGENCY OPERATION AND WARNING PLAN.
POCONO HIGHLAND DAM
1 DWELLING
3 DWELLINGS
1
2
3
APPROXIMATE MINIMUM LIMITS OF DOWNSTREAM FLOODING SHOULD DAM FAILURE OCCUR
SMALL DAM
MEADOW LAKE DAM
U.S. ROUTE 209
2000 0 2000
SCALE: 1 IN. = 2000 FT.
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
POCONO HIGHLAND DAM
POCONO HIGHLAND CAMPS, INC.
DOWNSTREAM DEVELOPMENT PLAN
JULY 1981
EXHIBIT D-1

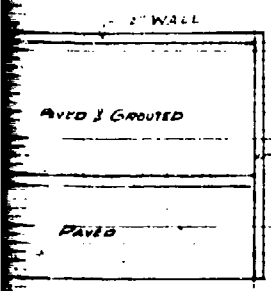
APPENDIX E

PLATES

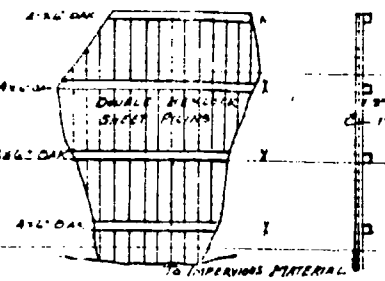

POCONO HIGHLAND DAM
7 1/2 MINUTE QUADRANGLES:
BUSHKILL, PA. - NJ.
PA ROUTE 402
POCONO HIGHLAND DAM
SMALL DAM
SPRING RUN
SMALL DAM
MEADOW
LAKE DAM
U S ROUTE 209
2000 0 2000
SCALE: 1 IN. = 2000 FT.
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
POCONO HIGHLAND DAM
POCONO HIGHLAND CAMPS, INC.
LOCATION MAP
JULY 1981
PLATE E-1



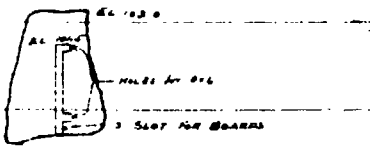
WALL
PAVED & GROUTED
PAVED
EARTH
EARTH & STONE
CLAY PUDDLE
12" C.I. OUTLET PIPE
TO IMPERVIOUS MATERIAL
Scale: 1"=10'
MAXIMUM SECTION SCALE 1"=10'
TOP OF DAM
TOTAL LENGTH 305'
PROFILE
PLAN 1"=20'



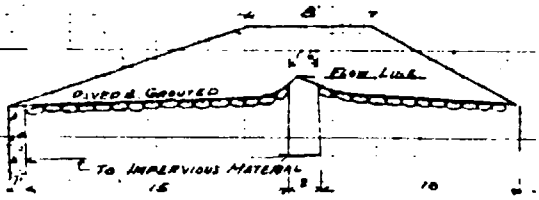
PLAN OF SPILLWAY
SCALE 1"=



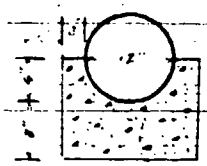
SECTION SHEET PILING END VIEW
SCALE 1"=5'



SECTION SHOWING THE CONNECTION OF THE TIMBER CORE WALL WITH THE SPILLWAY ABUTMENT

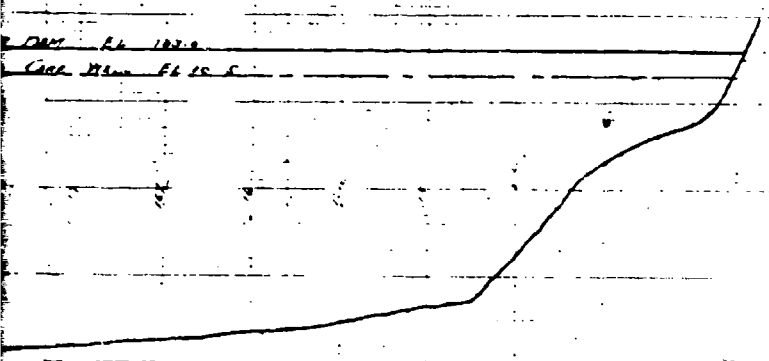


SECTION OF SPILLWAY
SCALE 1"=5'



SECTION OF CONCRETE CRADLE
SCALE 1"=1'

SCALE: 1"=10'

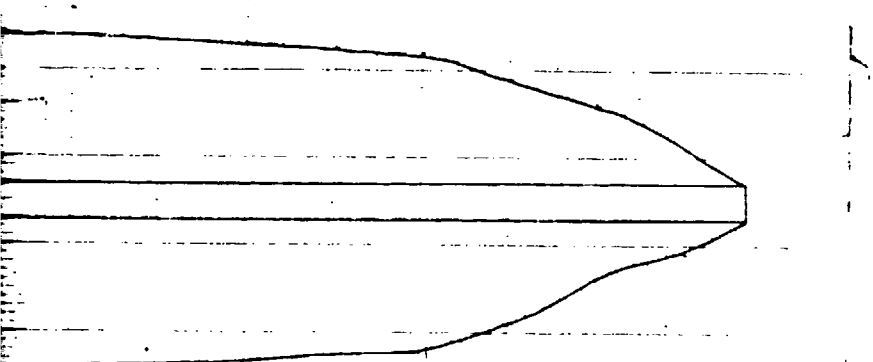


PROFILE SCALE HOR 1"=20
VER 1"=5

PLAN OF DAM
FOR
DR C B ROSENKRANS
ON
SPRING RUN LN
MIDDLE SMITHFIELD TWP
MONROE CO PA

DRAINAGE AREA 1 SQ.M
AREA FLOODED 12 A

SEPT 12 1957



DITCH TO STREAM

SCALE RECORDS SECTION 10X10 T

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

POCONO HIGHLAND DAM

POCONO HIGHLAND CAMPS, INC.

PLAN, PROFILE AND SECTIONS

JULY 1981 PLATE E-2

APPENDIX F

GEOLOGY

POCONO HIGHLAND DAM

APPENDIX F

GEOLOGY

Pocono Highland Dam is located in Monroe County within the Appalachian Plateau Province. The most pronounced topographic feature in the area is Camelback Mountain, which is a part of the Pocono Plateau Escarpment. The escarpment is well defined southwestward from Camelback Mountain, but is more irregular between Camelback Mountain and Mt. Pocono, which lies to the north. Streams east of the escarpment drain directly to the Delaware River, while those to the west drain to the Lehigh River.

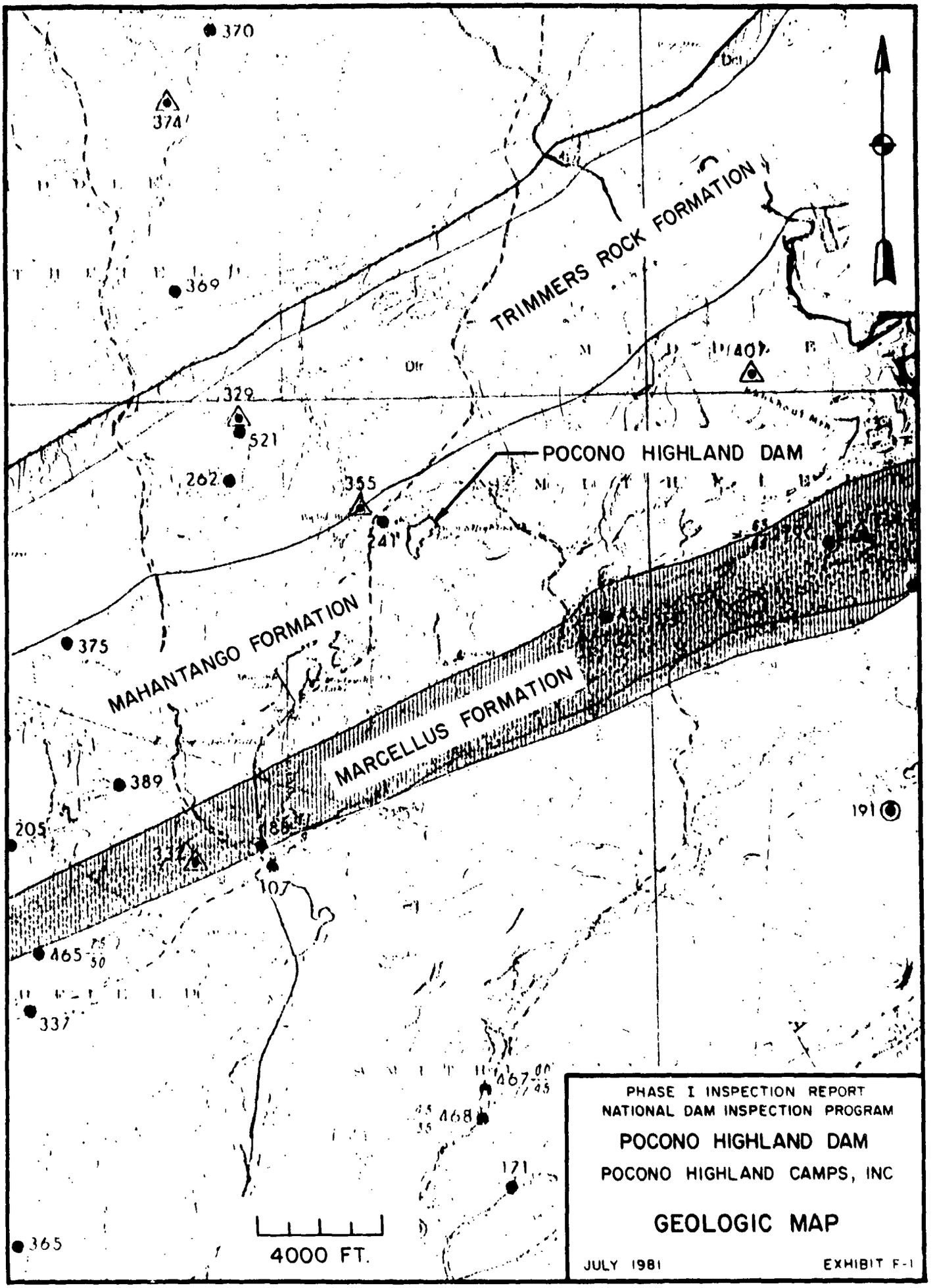
The Pocono Plateau Section lies west of the escarpment. This area is relatively flat, with local relief seldom exceeding 100 feet. The topography has been greatly influenced by continental glaciation. Many features were created by deposition of glacial materials. The entire plateau lacks well-developed drainage.

East of the escarpment is the Glaciated Low Plateaus Section of the province. The area is characterized by pre-glacial erosional topography with locally-thick glacial deposits. Local relief is generally 100 to 300 feet.

Bedrock units of the sections described above are the lithified sediments of offshore marine, marginal marine, deltaic and fluvial environments associated with the Devonian Period. These units include siltstones of the Mahantango Formation, siltstones and shales of the Trimners Rock and seven mapped members of the Catskill Formation. These members include sandstones, siltstones, and shales of the Towamensing Member; sandstone, siltstone and shale of the Wallacksville Member; sandstones, siltstones and shale of the Beaverdam Run Member; sandstone and shale in the Long Run Member; sandstones and conglomerates in the Packerton Member; sandstone and some conglomerates in the Poplar Gap Member; and sandstones and conglomerates in the Duncannon Member.

Pocono Highland Dam is underlain by the Mahantango Formation. This formation is predominantly siltstones and silty shales with some interbedded sandstones. Bedding is generally well developed and ranges from very thin bedded to thickly laminated. Joints are closely spaced, well developed, open and steeply dipping. The formation is reported to provide a good foundation for heavy structures when excavated to sound rock.

Shale outcrops at the right abutment of the dam. There are no records of the foundation of the embankment or spillway.



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

POCONO HIGHLAND DAM

POCONO HIGHLAND CAMPS, INC

GEOLOGIC MAP

JULY 1981

EXHIBIT F-1